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Linux Administration

**Ubuntu Server: Installs, Updates, and Documentation**

**Repositories**

Linux distributions have built in repositories that have all the packages needed to run compatible software programs (Holden-Gouveia, 2024). They are a way to collect and organize software so that it can be easily installed.

For the Ubuntu server, you need to first find the built-in repositories which should be located in the /etc/apt directory. To view what is inside the /etc/apt directory, you can change directories by using the command **cd /etc/apt**. Then you can view the contents of that directory by using the command **ls** **-l**.

**Figure 1.1** Image showing the contents of the /etc/apt directory

A screenshot of a computer

Description automatically generated

The repositories are listed in the sources.list or sources.list.d files. First, I used the nano text editor to open sources.list and received a message that all of the source repositories were in the sources.list.d directory.

**Figure 1.2** Message showing that the Ubuntu sources moved to sources.list.d

A screenshot of a computer

Description automatically generated

I changed to the sources.list.d directory and used **ls -l** to see the contents. On Oct. 5, 2024, I made a copy of the directory as a safeguard in case I accidentally changed something I shouldn’t. According to Pun (2020), the sources.list.d directory shows the configuration files for the Linux Advanced Packaging Tool that contains information “for remote repositories from where software packages and applications are installed.” When the installation command is executed, the package management tool finds the remote repository link and searches for the applicable application to be downloaded.

**Figure 1.3** Content of sources.list.d and the command to create a backup.

A screenshot of a computer screen

Description automatically generated

It is important to check that everything copied correctly so I cd to the backup directory and verified the contents.

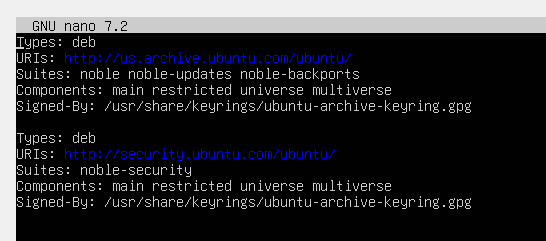
**Figure 1.4** Verification that October 5, 2024 backup included all files

A screen shot of a computer

Description automatically generated

In the ubuntu.sources file the repositories were listed. Elements of the repository were Types, uniform resource identifiers (URIs), Suites, Components, and Signed-By. For the repositories shown below in Figure 1.5, the “deb” Types illustrated that the type of files would be precompiled Debian source files. The URIs are internet links to where the repository is stored. The “Suites” section details the release name of the distribution (Ubuntu, 2015). The “Components” section illustrates the ways that the software is available to end users, and the “Signed-By” section illustrates a chain of key signatures that essentially says that the software is legitimate (Ubuntu, 2024). To add a new repository, you can use the command **sudo add-apt-repository ppa:<repository name>** (Ubuntu, 2015).

**Figure 1.5** Results showing Ubuntu’s built in repositories



**Installation**

In this tutorial, the following software programs will be installed on the Ubuntu server: tmux, emacs, fail2ban, cowsay, lolcat, and vim (if not already installed). To install the programs, use the command **sudo apt install <program name>**. Before doing that, it is always good to update your system first. This can be done with the command **sudo apt update**.

**Figure 1.6** Image showing the results of **sudo apt update** on October 5, 2024

A screenshot of a computer

Description automatically generated

**Tmux**

Tmux is a terminal multiplexrer, which means that it can allow a user to create multiple “pseudo terminals” from a single terminal window (Gerardi, 2022). Tmux sessions can be detached from the terminal and run in the background which can be helpful for long running processes. Tmux was installed by typing the command **sudo apt install tmux**. To verify that tmux installed correctly, you can type **tmux** in the command line to open the program. This opens the tmux server and creates a default session (0). In the session, you can use the terminal normally to run programs or commands.

**Figure 1.7** Image showing the tmux screen





To detach from the tmux session, select **Ctrl+B** then **D**.

**Figure 1.8** Image showing the screen after the session is detached.

A black and white screen with white text

Description automatically generated

To find out where the tmux files are located, use the command **whereis tmux**.

**Figure 1.9** Image showing the location of the tmux files



**Emacs**

Emacs is a popular, text editor that can also function as an integrated development environment (IDE) for different programming languages (Hussain, 2023). Emacs was installed by typing the command **sudo apt install emacs**.

**Figure 1.10** Sample of emacs installation

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Description automatically generated

During the installation, a prompt required me to select a configuration for postfix. Postfix is a mail transfer agent that was downloaded as part of emacs (Drake & Camisso, 2022). I chose the ‘No configuration’ option for this application, because I was not interested in using the agent at this time.

**Figure 1.11** Image of Postfix configuration options

A screenshot of a computer

Description automatically generated

To verify that emacs installed correctly, type **emacs**. Next, the emacs menu will appear on the screen.

**Figure 1.12** Image showing the emacs help menu

A screenshot of a computer

Description automatically generated

To learn how to work in emacs you can read the tutorial, or select some of the links in the main menu. Below is an example of creating a new file from selecting the Visit New File option. To exit emacs, you have to select **Ctrl + X + C**.

**Figure 1.13** Image showing a new file created in emacs

A black and white screen with a black text

Description automatically generated

To find where emacs is stored on the server, type the command **whereis emacs**.

**Figure 1.14** Image showing the results of **whereis emacs**



**Fail2ban**

Fail2ban is a program that is used to secure a Linux system against malicious logins (Prakash, 2019). Fail2ban was installed by typing the command **sudo apt install fail2ban**.

**Figure 1.15** Image showing the installation of fail2ban

A screenshot of a computer

Description automatically generated

To Start fail2ban, use the command **systemctl start fail2ban**. As fail2ban starts, the program will require you to authenticate several times.

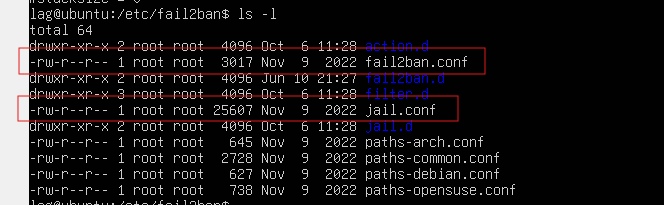
**Figure 1.16** Image showing fail2ban starting and the authentication requests.

A screenshot of a computer program

Description automatically generated

Fail2ban has two primary configuration files – fail2ban.conf and jail.conf. The fail2ban.conf file is the file that manages the operational settings of the fail2ban daemon. The jail.conf is where a user can customize configurations like setting allowlists and denylists by typing directly into the file.

**Figure 1.17** Image showing the files in the fail2ban directory



**Figure 1.18** Image showing a snippet of the fail2ban.conf file

A screenshot of a computer program

Description automatically generated

**Figure 1.19** Image showing a snippet of the jail.conf file

A screenshot of a computer

Description automatically generated

To see where fail2ban is on your linux system, use the command **whereis fail2ban**.

**Figure 1.20** Image showing the results of the whereis fail2ban program.

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Description automatically generated

**Cowsay**

Cowsay is a fun tool that can display a cow in the terminal along with a message (Sreenath, 2023). Cowsay was installed by typing the command **sudo apt install cowsay**.

**Figure 1.21** Image showing the installation of cowsay

A screenshot of a computer program

Description automatically generated

To use cowsay, you type the command **cowsay** followed by text. To test that cowsay was installed correctly, I typed **cowsay Good Morning!**

**Figure1.22** Image showing the results of **cowsay Good Morning!**

A screenshot of a computer screen

Description automatically generated

You can also use options with cowsay. For instance, the -g option shows a “greedy” cow with dollar signs for eyes.

**Figure 1.23** Image showing the results of cowsay with the -g option saying “I want all the food!”

A screenshot of a computer screen

Description automatically generated

To see where cowsay is located, use the **whereis** command.

**Figure 1.24** Results of **whereis cowsay** command



**Lolcat**

Lolcat is another fun program that can add a rainbow of colors to the Linux terminal (Saive, 2023). Lolcat was installed by typing the command **sudo apt install lolcat**.

**Figure 1.25** Image showing the installation of lolcat

A screen shot of a computer

Description automatically generated

To see if lolcat installed correctly, I typed the command **lolcat -h** to view the help menu.

**Figure 1.26** Image showing the lolcat help menu

A computer screen shot of a program

Description automatically generated

Lolcat can be used to read files like cat, or can be used in the terminal with other commands like cowsay. Below is an example of cowsay used with lolcat.

**Figure 1.27** Image of cow and colored text saying “Can this cow change colors?”

A screenshot of a computer

Description automatically generated

To see where lolcat is located, use the **whereis** command.

**Figure 1.28** Results of **whereis lolcat** command

A black and white text

Description automatically generated

**Vim (Vi Improved)**

Vim is a powerful text editor that was already installed on the Ubuntu server. Some of vim’s top features are that it can support hundreds of programming languages and file formats, can be used for search and replace, and can integrate with other tools (Vim, 2024). Type **vim** to open vim in the terminal.

**Figure 1.29** Image showing the results of typing vim in the terminal

A screen shot of a computer

Description automatically generated

To create a file you can type **:i** to go to insert mode.

**Figure 1.30** Example of text typed into a vim file using insert mode.

A black background with a black square

Description automatically generated with medium confidence

To exit vim, type **:q**.

To see the where the vim files are located, use the **whereis vim** command.

**Figure 1.31** Results of **whereis vim** command

A black and white screen with white text

Description automatically generated

**Part 2: CentOS Server: Installs, Updates, and Documentation**

**Repositories**

Linux distributions have built in repositories that have all the packages needed to run compatible software programs (Holden-Gouveia, 2024). They are a way to collect and organize software so that it can be easily installed.

For the CentOS server, the built-in repositories are located in the /etc/yum.repos.d directory (Naver Cloud, 2024). To view what is inside /etc/yum.repos.d directory, change to that directory and view the contents of that directory by using the command **ls -l**.

**Figure 2.1** Image showing the contents of the /etc/yum.repos.d A screenshot of a computer

Description automatically generated

The CentOS working repositories are in the centos.repo file. The additional CentOS repositories are in the centos-addons.repo file.

**Figure 2.2** A snippet of the results of **cat centos.repo**

A screenshot of a computer program

Description automatically generated

**Figure 2.3** A snippet of the results **of cat centos-addons.repo**

A screen shot of a computer

Description automatically generated

The structure of the repo files includes a header, or repo id shown in brackets at the top (Reselman, 2022). Next is the name, in this case CentOS Stream. The next line is a metalink link that points to an XML document that lists the locations where the repository data can be found. After that is a gpgkey which is used to verify the authenticity of the software. Next is the gpgcheck which indicates that the system will verify the digital signatures of the package before installing them. The next setting is repo\_gpgcheck which indicates whether GPG checking is set for the repository. The default for repo\_gpgcheck is zeo, or false. The metadata\_expire indicates how often the repository metadata should be refreshed. This document also includes information that can be used to verify the accuracy and integrity of the data in those repositories. The enabled indicator defines whether the repository is enabled for use. The count me line setting indicates the number of times a repository has been used. To create a new repository you can use the command **yum install <repository URL>** (Marrich, 2020).

**Installation**

In this tutorial, the following software programs will be installed on the CentOS server: tmux, emacs, fail2ban, cowsay, lolcat, and vim (if not already installed). To install the programs, you can use the command **sudo dnf -y install <program name>** (Marijan, 2022). The dnf is a newer package management tool that aims to replace yum in new CentOS distributions (Marijan, 2023). The -y option automatically adds yes to all prompts. Before doing that, it is always good to update your system first. This can be done with the command **sudo yum update**. The CentOS system was updated on October 6, 2024.

**Tmux**

Tmux is a terminal multiplexer, which means that it can allow a user to create multiple “pseudo terminals” from a single terminal window (Gerardi, 2022). Tmux sessions can be detached from the terminal and run in the background which can be helpful for long running processes. Tmux was installed by typing the command **sudo dnf -y install tmux**.

**Figure 2.4** Image showing the tmux installation

A screenshot of a computer

Description automatically generated

To verify that tmux installed correctly, you can type tmux in the command line to open the program. That will connect to the tmux server and open a new session (0) in the window.

**Figure 2.5** Snippet showing the tmux screen

A screenshot of a computer

Description automatically generated

To detach from the session select **Ctrl+B** then **D**.

**Figure 2.6** Image showing the screen after detaching from the session

A black background with white text

Description automatically generated

To find out where the tmux files are located, use the command **whereis tmux**. The image below shows where the tmux files are located.

**Figure 2.7** Image showing location of tmux files



**Emacs**

Emacs is a popular, text editor that can also function as an integrated development environment (IDE) for different programming languages (Hussain, 2023). Emacs was installed by typing the command **sudo dnf install emacs**. The -y option did not work for this program, as there was an error caused by a plugin that interfered.

**Figure 2.8** Snippet of emacs installation

**A screenshot of a computer

Description automatically generated**

To verify that emacs installed correctly, type **emacs**. On CentOS, the emacs graphical user interface (GUID) will appear on the screen.

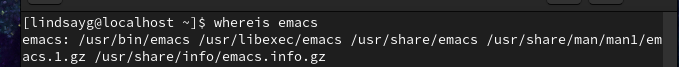
**Figure 2.9** Image showing the emacs GUI

A screenshot of a computer

Description automatically generated

Because emacs has the GUI, it is very easy to open a file, start a new file, and exit. There was not an option for a command line only install. To find where emacs is stored on the server, type the command **whereis emacs**. Below is an image showing where the various emacs files are stored on the server.

**Figure 2.10** Image showing the results of **whereis emacs**



**Fail2ban**

Fail2ban is a program that is used to secure a Linux system against malicious logins (Prakash, 2019). I attempted to install Fail2ban by typing the command **sudo dnf -y install fail2ban**. I received an error that said there was no match for fail2ban.

**Figure 2.11** Image showing the failed installation of fail2ban

A screen shot of a computer

Description automatically generated

To install fail2ban on CentOS, you have to first install the Extra Packages for Enterprise Linux (EPEL) (UpCloud, 2024). This can be done through the command **sudo yum install epel-release**.

**Figure 2.12** Snippet of the successful installation of EPEL

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Description automatically generated

Next, install fail2ban by typing the command **sudo yum install fail2ban**.

**Figure 2.13** Snippet of the successful installation of fail2ban

A computer screen with white text

Description automatically generated

After installation, make a copy of the jail.conf primary configuration file and save locally. This can be done with the command **sudo cp /etc/fail2ban/jail.conf /etc/fail2ban/jail.local.** It is recommended to customize the local configuration file as the primary configuration file will get overwritten or improved as the distribution is updated. To view and edit the local configuration file, open it up using a text editor.

**Figure 2.14** An image showing the jail.local file opened in nano

A screenshot of a computer

Description automatically generated

To start fail2ban, use the command **sudo systemctl start fail2ban**. To see the status of fail2ban **type systemctl status fail2ban**. To navigate away from this screen use **Ctrl + C**. To

**Figure 2.15** The image below shows the status of fail2ban running on the CentOS system.

A computer screen shot of a program

Description automatically generated

To see where fail2ban is on your linux system, use the command **whereis fail2ban**.

**Figure 2.16** Image showing the results of the whereis fail2ban program.



To stop the service use the command **sudo systmctl stop fail2ban**. To disable it from automatically starting up use **sudo ssystemctl disable fail2ban**.

**Cowsay**

Cowsay is a fun tool that can display a cow in the terminal along with a message (Sreenath, 2023). Cowsay was installed by typing the command **sudo dnf -y install cowsay**.

**Figure 2.17** Image showing a snippet from the installation of cowsay

A screenshot of a computer

Description automatically generated

To use cowsay, you type the command **cowsay** followed by text. To test that cowsay was installed correctly, I typed **cowsay Will this work the same?**

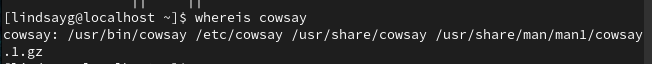
**Figure 2.18** Image showing the results of **cowsay Will this work the same?**

A screenshot of a computer

Description automatically generated

To see where cowsay is located, use the **whereis** command.

**Figure 2.19** Results of **whereis cowsay** command



**Lolcat**

Lolcat is another fun program that can add a rainbow of colors to the Linux terminal (Saive, 2023). To install lolcat on the CentOS, a few steps needed to happen first (Raghuvanshi, 2024). The first step was to install the epel-release repository, but that was already done in a prior installation on October 6, 2024. The next step was to install the Snap app store that contains Linux applications such as lolcat. The commands to install snap and enable communication were **sudo yum install snapd**, **sudo systemctl enable –now snapd.socket**, **and sudo ln-s /var/lib/snapd/snap /snap**. To ensure that the paths update correctly, it is recommended to restart your system. After the restart lolcat can be installed with the command **sudo snap install lolcat-rs**. The -rs at the end represents that this is the Rust re-implementation of the original lolcat which is newer and has no dependencies.

**Figure 2.20** Image showing the installation of lolcat

A screenshot of a computer screen

Description automatically generated

Lolcat can be used to read files like the **cat** command, or can be used in the terminal with other commands like **cowsay**. Below is an example of cowsay and echo being used with lolcat-rs.

**Figure 2.21** Image of echo command and “Hello! “with a cow and colored text saying “It works!”

A screenshot of a computer

Description automatically generated

To see where lolcat is located, use the **whereis** command.

**Figure 2.22** Results of **whereis lolcat-rs** command

A black background with white text

Description automatically generated

**Vim (Vi Improved)**

Vim is a powerful text editor that was already installed on the CentOS server. Some of vim’s top features are that it can support hundreds of programming languages and file formats, can be used for search and replace, and can integrate with other tools (Vim, 2024). Type **vim** to open vim in the terminal.

**Figure 2.23** Image showing the results of typing vim in the terminal

A screenshot of a computer program

Description automatically generated

To create a file you can type **:i** to go to insert mode.

**Figure 2.24** Example of text typed in a vim file using insert mode.

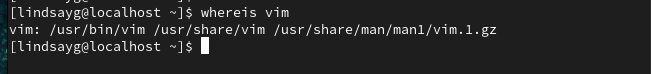
A screenshot of a computer

Description automatically generated

To exit vim, type **:q!**.

To see the where the vim files are located, use the **whereis vim** command.

**Figure 2.25** Results of **whereis vim** command



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